

# Land Use Changes of Mata Lake Using Multi-temporal Satellite Imageries

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**Abstract:** Land use and protection has become a global hot spot. How to use land resources is an important topic for the future socio-economic sustainable development. This paper analyzes the land use changes of Mata lake of Shandong province in China, from 1985's to 2000's using multi-temporal remotely sensed data including TM in the 1985s, ETM+ in the 2000s and ancillary data such as soil use map, water map etc. The remote sensing imagerys were calibrated, registered and geo-referenced, then classified by multi-source information data and remote sensing image interpretation expert system based on knowledge base. Five land use types were extracted from remote sensing imagerys, that is, water body, agriculture land, rural settlement, bare land and non-use land. The total precision is 80.7% and Kappa index is 0.825. The analysis result of the remote sensing shows that during the past 15 years, water resource dropped off very promptly from 51.77 km<sup>2</sup> to 16.65 km<sup>2</sup> and bare land reduced greatly more than 60% in Mata lake region. With the development of the economy and agriculture areas, more and more water body and bare land converted to agriculture land use and rural settlement areas. Since last years, the Mata lake has been affected by natural factor, human activity and increasing population. So its land use pattern greatly changed from 1985 to 2000. The information of land use changes provided scientific supports for land planning and environmental protection.

**Key words:** land use; TM/ETM+ imagerys; mata lake; expert system

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## 1 Introduction

Spatial information technology (including GIS, RS and GPS) has been proved important technology for resources management and utility<sup>[1]</sup>. Especially with the development of remote sensing technology, people begin to analyze natural phenomena and environment changes more flexible and useful. Models based on GIS and RS data have been used for many years as the basis of assessing the changes of the land use and land coverage. Remote sensing technology also assists us to link the relationship between land use and ecological environment to sustain society sustainable development.

The research of land use and land cover changes (LUCC) has become a global hot spot. How to use land resources is an important topic for the future socio-economic sustainable development<sup>[2]</sup>. Especially the third world country, for example, China, is a big agricultural country. Concerns are raised about the impact of the land use changes though the definition of land use changes is not easy. This paper introduces the land use changes information of Mata lake last 15 years using Landsat TM/ETM imagerys. It is a good example for land use changes in the east China.

## 2 Study Site and Data

### 2.1 Study Site

The study area, Mata lake, the town of Shandong prov-

ince, with a geographic location of 35° N and 118° E, situates in the North of the Huanghe River of Shandong province, China. Mata lake belongs to subtropical humid monsoon climate zone, characterized as four obvious seasons. It's annual average temperature is 26℃, annual average rainfall nearly 627.4 mm and annual sunlight more than 2 542 hours<sup>[3]</sup>. Most of the area is covered with ever-green forest and many lakes are distributed around this region.

### 2.2 Data Adopted

Data adopted in this paper is composed of spatial data and attribute data of society development and national economy. Spatial data includes remotely sensed data and map data. In this area, remotely sensed data were TM/ETM+ imagerys in 1985 and 2000, respectively, corresponding to path 130 and row 32 (scene No. 130-32). Ancillary data consist of topographical maps with the scale of 1:20 000 in 1990, DEM with the scale of 1:20 000 and thematic maps of Mata lake area, such as some land use map, vegetation map, climate map, and social-economic statistical data from local departments.

## 3 DTA Preprocessing and Technique Route

Two scenes remotely sensed data processed include radiation correction, geometric calibration, and projection transformation. TM and ETM+ imagerys were rectified to Gauss-

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Kruger Zone 18 projection, and then image Merging was done<sup>[4]</sup>. In this paper, false color composite Landsat 7 Enhanced Thematic Mapper (ETM+) imageries of band 4, 3, 2 taken in 2000 and Thematic Mapper (TM) imageries of 4, 3, 2 taken in 1985 were used for the reorganizing the data of in this area.

Because this paper mainly analyzes the land use changes of the spatial distribution in Mata lake region. Every type of land use was extracted from the results of the classification carefully. Technique frame to exact changes of land use information follows ( Fig. 1 ).

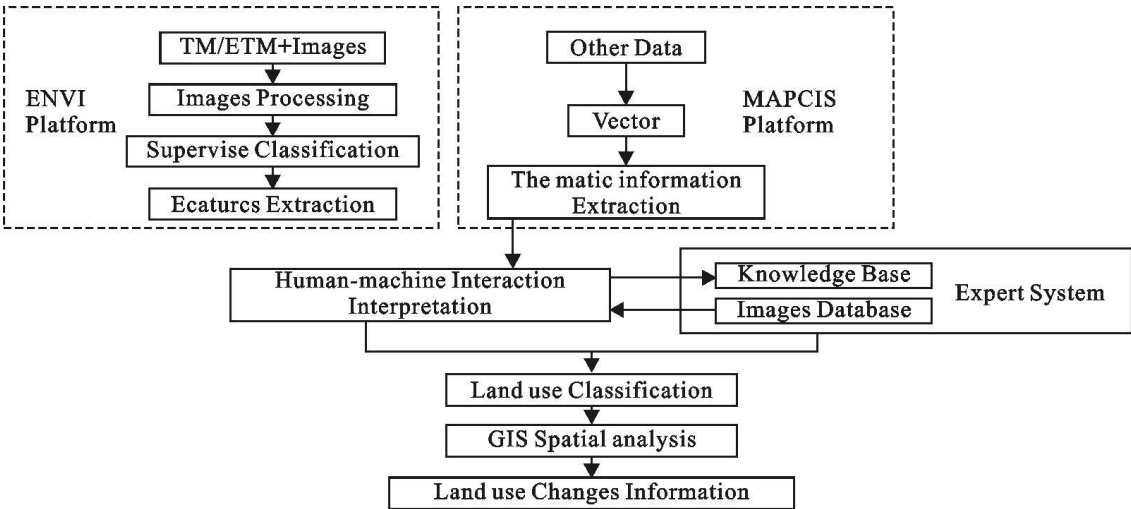


Fig. 1 Technique frame to extract land use changes information

4 Image Interpretation

4.1 Information Extraction of Land Use Changes

Land use changes information was extracted in the study site using the methods of human-machine interaction interpret and expert system. During the human-machine interaction interpret, preliminary interpretation mark was established according to topography and thematic maps and etc., and then the maximum likelihood of supervised classification was done in the environment of ENVI<sup>[5]</sup>. As far as uncertain types were concerned, expert system based on knowledge base was used to establish high accuracy interpretation marks for improving the classification accuracy. Finally, vector data were gained by MAPGIS software<sup>[6]</sup>, including vector and raster transformation, topology creating, polygon eliminating and merging. A system of land use classification was established in which land use was grouped into 5 categories (water body, agriculture land, rural settlement, bare land and none use land). And the land use classification maps were acquired satisfactory.

4.2 Accuracy Evaluation

It is necessary to evaluate classification of the research. By virtue of the module of accuracy assessment in the environment of EVNI software, using the methods of drawing samples randomly, 250 grounds are selected to investigate and verify in the study site. Total accuracy of classification and Kappa index are gained by comparison with reference pixels in accuracy. The result of the total accuracy is 80.7% and Kappa index is 0.825. With the help of human-machine interaction interpret and expert system, accuracy is improved greatly.

Table 1 Land use of different type in 1985 and 2000

Land use type	km <sup>2</sup>	
	1985	2000
Water body	51.77	16.65
Agriculture land	109.01	150.27
Rural settlement	39.32	109.39
Bare land	94.31	18.09
None use land	8.11	8.12
Total	302.52	302.52

4.3 Results

The total area of the study site in Mata lake is 302.52 km<sup>2</sup> in 1985, most of it is agriculture land and bare land, namely that 109.01 and 94.31 km<sup>2</sup>, accounting for 36% and 31.2% respectively. Water body of Mata lake region in 1985 is 51.77 km<sup>2</sup>, rural resident area 39.32 km<sup>2</sup>, and none use land 8.11 km<sup>2</sup>, respectively ( Fig. 2 ).

In 2000, the total area of the study site is still 302.52 km<sup>2</sup>, but most of it is agriculture land and rural resident area. Water body decreased, namely that 16.65 km<sup>2</sup>, accounting for 5.5% of the total area, and rural resident area increased, namely that 109.39 km<sup>2</sup>, accounting for 36.2% of the total area. On the other hand, 35.12 km<sup>2</sup> water body lost and two-thirds of it in 1995, and 76.22 km<sup>2</sup> bare land decreased and nearly one-third of it in 1985. At the same time, agriculture land increased 41.26 km<sup>2</sup>, more than 35%, while none use land is nearly the same as it in 1985 ( Fig. 3 ).

5 Conclusion

We can see from the Fig. 2 and Fig. 3 that rural settlement and agriculture land grow rapidly from 1985 to 2000. In 1985, rural settlements mainly distribute the north of the Mata lake, while distributing the north and south of this area.

a. During this 15 years, water resource dropped off very promptly from 51. 77 km<sup>2</sup> to 16. 65 km<sup>2</sup> and bare land reduced greatly more than 60%. There are many reasons for the land use changes of the Mata lake. On the one hand, natural environment changes make people using land again. On the other hand, the growth of population makes many rural houses built as the improvement of life.

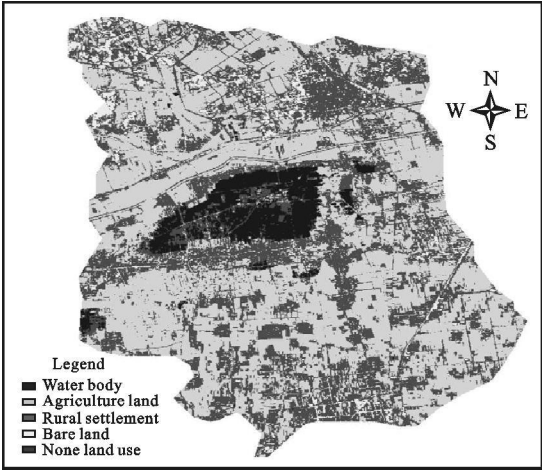


Fig. 2 Land use of Mata lake in 1985

This research is aimed to study the ecological environment problems of land use changes in Mata lake, which is related to sustainable development of more than 300 km<sup>2</sup>. It is helpful to provide proof in decision making on resources management and to provide scientific supports for land planning and environmental protection<sup>[7]</sup>.

References:

[ 1 ] Tong Qingxi. On the Geo-spatial Information Science [ J ]. Geography and Geo-Information Science, 2003, 19 ( 4 ): 1- 4 ( In Chinese ).

[ 2 ] WU Chuanjun. Land use in China [ M ]. Beijing: Science Press, 1994: 43- 87 ( In Chinese ).

[ 3 ] TAO Baoxian, YAN Wujiu. The Retrospective Assessment and Analysis about Air-quality of Zibo city in Shandong Province [ J ]. Environmental Science and Management, 2006, 31 ( 2 ): 149- 152 ( In Chinese ).

[ 4 ] Wang Yanmin. Research on Quick Band-change algorithm of Gauss projection for Multi-source GIS [ J ].

With the improvement of economy and technology, a large proportion of agriculture land had been reclaimed from bare land to meet people needs. With regard to this study site, problems of ecological environment is mainly aroused by rural settlement increasing and bare land decreasing, while other land use also has changed.

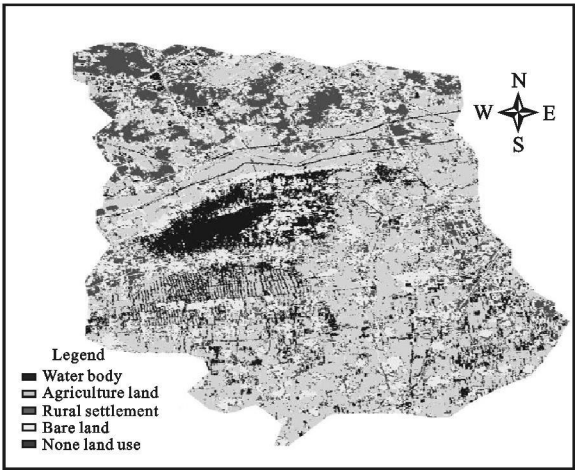


Fig. 3 Land use of Mata lake in 2000

Engineering of Surveying and Mapping, 2002, 11 ( 1 ): 8 - 13 ( In Chinese ).

[ 5 ] ZHANG Yinhui, ZHAO Gengxing. The Research of Farm Land Information Secondary Planet Remote Sensing Computer Automatic Extraction Techniques Using the ENVI software [ J ]. Journal of Sichuan Agricultural University, 2000, 18 ( 2 ): 170- 172 ( In Chinese ).

[ 6 ] YANG Zhi, GUO Fusheng, LIU Linqing. Research and Realization of Danxia Landform Information System of Jiangxi Province Based on Map GIS [ J ]. Geomatics and Spatial Information Technology, 2006, 29 ( 1 ): 64 - 66 ( In Chinese ).

[ 7 ] LIANG Handong, CHEN Weibing, CHEN Chao. Study and Application of the Urban Environmental Protection Information System Based on Com-GIS [ J ]. Journal of Remote Sensing, 2006, 10 ( 3 ): 319- 325 ( In Chinese ).